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WATER QUALITY CONTROL STUDY, ELKHORN
RIVER BASIN, NEBRASKA. STUDY OF THE NEED
AND VALUE OF STORAGE FOR WATER QUALITY
CONTROL

Federal Water Pollution Control Administration
Kansas City, Missouri

December 1965

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WATER QUALITY CONTROL STUDY ELKHORN RIVER BASIN NEBRASKA

**Study of the Need and Value of
Storage for Water Quality Control**



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**U. S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
Public Health Service
Region VI
Kansas City, Missouri
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WATER QUALITY CONTROL STUDY

**ELKHORN RIVER BASIN
(Nebraska)**

A study has been made of the Elkhorn River Basin, Nebraska, which discloses no present or future need (to the year 2015) for the inclusion of storage for water quality control in the proposed reservoirs. These conclusions are based on analysis of existing water quality information and hydrologic, economic and demographic analyses. Future needs are based on projected population and industrial growth.

Prepared for

U. S. DEPARTMENT OF INTERIOR

**BUREAU OF RECLAMATION, REGION 7
Niobrara-Lower Platte Projects
Grand Island, Nebraska**

**U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service, Region VI
Kansas City, Missouri
December 1965**

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Exhibit No.

- 1 Municipal Water Supplies
- 2 Basic Data on Sources of Pollution
- 3 Historical Streamflows

I. INTRODUCTION

Request and Authority

In a letter dated December 13, 1963, the Niobrara-Lower Platte Projects Office of the Bureau of Reclamation, Region 7, requested the Public Health Service to determine present and prospective needs for water for water quality control in the Elkhorn River Basin, Nebraska.

This request was in accordance with the Federal Water Pollution Control Act, as amended (33 U.S.C. 466 et seq).

Purpose and Scope

The purpose of this study is to determine the need for and value of storage for streamflow regulation for water quality control in the Elkhorn River Basin in northeastern Nebraska.

The basin has an area of approximately 6,900 square miles and includes all or parts of Rock, Holt, Antelope, Knox, Pierce, Wayne, Garfield, Wheeler, Madison, Stanton, Platte, Cuming, and Dodge Counties.

This study covers the 50-year study period, 1965 to 2015, as requested by the Bureau of Reclamation.

Acknowledgments

The cooperation of many persons and agencies is gratefully acknowledged. Special appreciation is expressed to the following:

1. Department of Water Resources, Lincoln, Nebraska
2. Nebraska Department of Health, Lincoln, Nebraska
3. Conservation and Survey Division, University of
Nebraska, Lincoln

4. Bureau of Reclamation, Region 7, Niobrara-Lower
Platte Projects Office, Grand Island, Nebraska
5. U.S. Geological Survey, Lincoln, Nebraska

II. SUMMARY OF FINDINGS AND CONCLUSIONS

Summary of Findings

1. The Bureau of Reclamation is making a study of the Elkhorn River Basin in Nebraska to determine the feasibility of constructing multipurpose reservoirs, diversion dams and canals primarily for irrigation and also to serve the coordinate purposes of recreation, fish and wildlife, flood control and municipal and industrial water supplies and water quality control if needed.

2. The study area includes all or parts of Rock, Holt, Antelope, Norfolk, Pierce, Wayne, Garfield, Wheeler, Madison, Stanton, Platte, Cuming and Dodge Counties.

3. The 1960 population of the study area was 118,413 of whom 43,657 were urban and 74,756 were rural.

Major municipalities in the basin include the following (1960 population shown in parentheses): Fremont (19,698), Wayne (4,217), West Point (2,921), Norfolk (13,640) and O'Neill (3,181).

4. Significant amounts of wastes are discharged at the following points (population equivalent discharged shown in parentheses): Fremont (84,000), West Point (2,660), Norfolk (15,000) and O'Neill (4,820).

Primary treatment is provided at Fremont, West Point and Norfolk and no treatment is provided at O'Neill.

5. The chemical quality of the surface and ground water in the basin is generally good and entirely acceptable for municipal, agricultural and most industrial uses. The water in the upper

portion of the basin is relatively better quality than that of the lower portion.

Conclusions

1. The population of the economic study area is projected to reach 200,000 in 2015.
2. It is anticipated that existing water supply sources are adequate to serve the future municipal and industrial demands.
3. With the provision of adequate waste treatment (considered capable of removing 85% of the BOD today and 90% by 2015) stream-flow requirements will increase from 11 mgd at the present time to 20 mgd in 2015 at Norfolk and from 128 mgd at the present time to 183 mgd in 2015 at Fremont. Since information on the effects of possible diversions upon the natural flows of the Elkhorn River are unknown, the computations used in determining the need for stream-flow regulation for water quality control were based on existing streamflow conditions. The natural streamflow equals or exceeds the flows that are anticipated to be required in 2015 in 90% of the years and is, therefore, considered adequate to assimilate all present and anticipated waste loads without streamflow regulation.
4. While there is no need for storage for streamflow regulation for water quality control, failure to maintain the above flows as a part of project management will result in the degradation of the quality of the Elkhorn River and will require the assessment of damages against other project features.

VII. PROJECT DESCRIPTION

The Bureau of Reclamation is making a reconnaissance study of the Elkhorn River Basin to determine the feasibility of constructing multipurpose reservoirs, diversion dams and canals primarily for irrigation and also to serve the coordinate purposes of recreation, fish and wildlife, flood control, and municipal and industrial water supply and water quality control if needed.

The proposed projects include the Saint Clair Reservoir near Neligh, Monterey Reservoir west of West Point, Pender Reservoir near Pender and diversion dams above Stanton and near Tilden. These projects are shown on Figure VII-2.

IV. STUDY AREA DESCRIPTION

Location and Boundaries

The Elkhorn River Basin, a part of the Platte River Basin, is bounded on the north by the Niobrara Basin, on the east by a topographical divide, east of which drainage flows directly to the Missouri River, and on the south and west by the North Loup Basin, Cedar River Basin, and other minor watersheds such as Beaver Creek and Shell Creek.

The total drainage area of the Elkhorn River is approximately 6,900 square miles. The basin is approximately 180 miles long and 60 miles wide at its widest point.

Geography and Topography

Land elevations in the Elkhorn River Basin range from approximately 1,100 feet at the confluence of the Platte and the Elkhorn Rivers to over 2,300 feet in the sand hills in the upper portion of the basin.

The basin covers parts of two well-defined physiographic divisions, the loess plains and the Sand Hills regions. The western part of the basin is in the Sand Hills region which is characterized by gently rolling to hilly terrain in loose sand. In the eastern part of the basin, the loess plains have been modified considerably by erosion and only a part remains to indicate the level of the former loess mantle. The topography is moderate to sharply rolling, except along the major drainage where broad flat terraces are found.

Climate

The climate of the basin is characterized by a rather wide range in temperature between winter and summer. It is generally well suited to raising livestock and growing feed and grain crops. The spring months are cool and have considerable rain; the summer months are warm and have moderate precipitation; the fall months are cool with only occasional rains; and the winter months have frequent low temperatures accompanied by snow.

At Norfolk near the center of the basin, the average annual temperature is near 49° F and has ranged from -39° F to 116° F. The annual precipitation averages approximately 26 inches and has ranged from a minimum of 13.8 inches to a maximum of 37.7 inches.

Principal Communities

There are five communities in the basin having populations exceeding 2,000 according to the 1960 census. They include Fremont (19,698), Wayne (4,217), West Point (2,921), Norfolk (13,640) and O'Neill (3,181).

V. WATER RESOURCES OF THE STUDY AREA

Surface Water

The Table of Historical Streamflows (Appendix, Exhibit No. 3) shows that the flow of the Elkhorn River at Waterloo, Nebraska, has ranged from a minimum of 50 cfs to a maximum of 100,000 cfs over more than 60 years of records. This station has a drainage area of 6,900 square miles.

Streamflow at other points in the basin range from 0.1 to 10,800 cfs at Nickerson on Maple Creek to 60 to 13,500 cfs on the Elkhorn River at Norfolk.

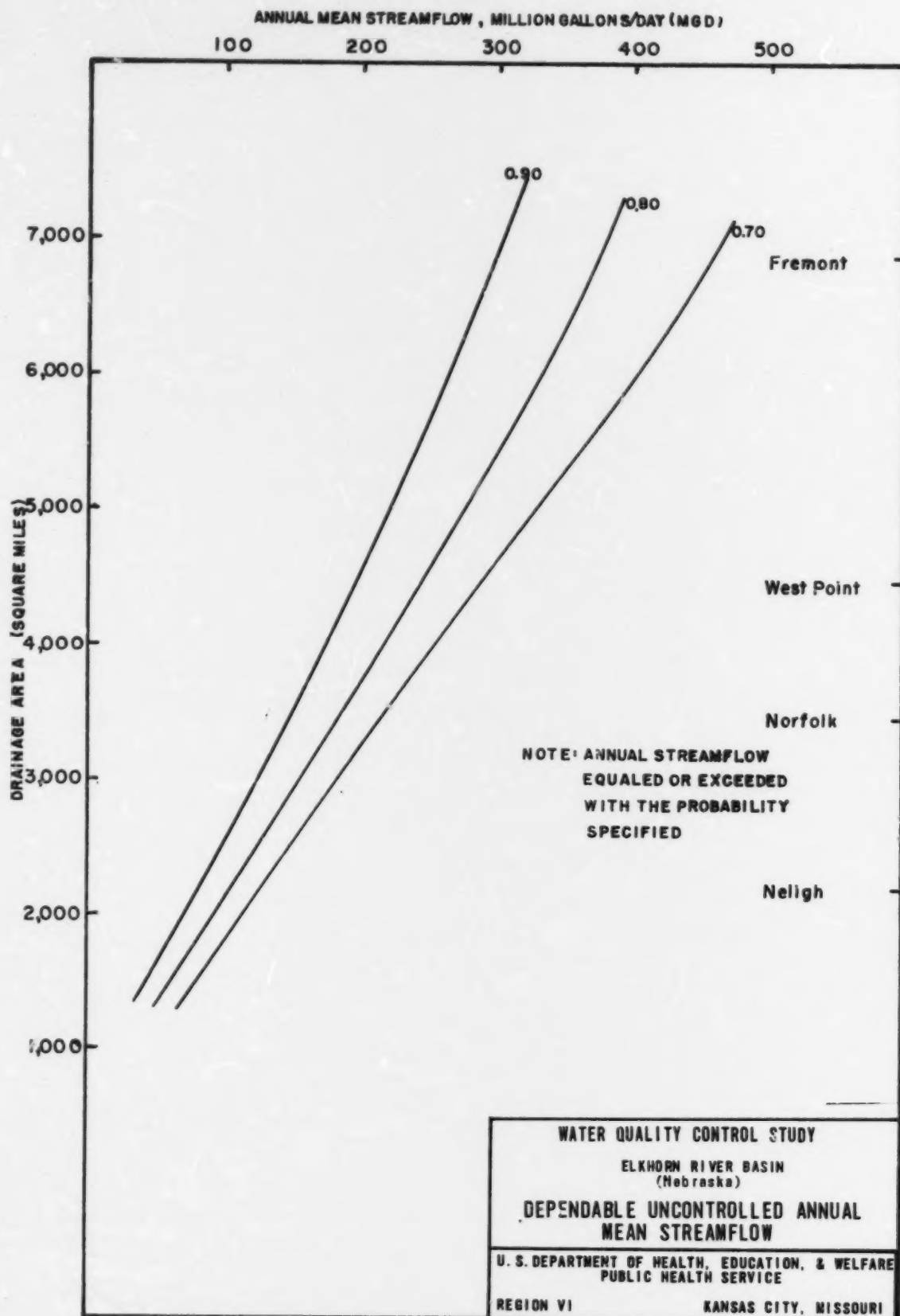
The dependable uncontrolled annual mean streamflow at locations in the Elkhorn Basin are shown in Figure V-1. The figure indicates, for example, that the annual mean streamflow equal to or greater than 299 mgd will be available 90 percent of the time at the point on the Elkhorn River where the Fremont, Nebraska wastes enter the stream.

The distribution of flow from month to month is more significant for water quality control purposes than differences from year to year.

Table V-1

Monthly Distribution of Annual Mean Streamflow

<u>Month</u>	<u>Percent of Annual Flow</u>
April	11
May	12
June	15
July	8
August	6
September	5
October	4
November	6
December	5
January	5
February	8
March	15



As shown in Table V-1, greater than average flows can be expected during only one-half of the summer period (June through September) when dilution requirements are greatest and less than average flows can be expected during the other one-half.

Ground Water

Ground water is developed extensively in the basin for municipal, domestic, industrial and irrigation uses. All municipal water supplies in the basin are supplied by ground water.

Abundant supplies of ground water are found in the Pleistocene Grand Island and Holdrege formations and the Pliocene Ogallala formation. Some water supplies are developed in the Cretaceous Dakota sandstone, but the well yields are not as high and the quality of the water is not as good.

It is expected that municipal and industrial water supply needs will continue to be met with ground water sources throughout the study period.

Quality of Water

The maximum and minimum concentrations of several chemical constituents of surface water of the Elkhorn River Basin are shown in Table V-2.

Ground water is progressively more mineralized toward the eastern

part of the basin. In the Sand Hills region the water is low in total dissolved solids, hardness, sulfate and chloride. It is similar to the quality of water of the Elkhorn River at Ewing (Table V-2).

In the eastern part of the basin, the quality of the ground water is similar to the surface water sampled on Logan Creek at Pender (Table V-2).

Table V-2

Maximum & Minimum Concentrations (mg/l)
of Selected Chemical Constituents

Elkhorn River Basin

	N. Fork Elkhorn R. near Pierce		S. Fork Elkhorn R. at Ewing		Elkhorn River at Ewing		Elkhorn River at Norfolk		Logan Creek at Pender	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
Dissolved Solids	367	149	243	127	214	145	326	171	516	360
Hardness	256	72	116	66	106	74	201	97	396	251
Chloride	4.6	0.0	3.2	0.0	3.8	0.0	118	0	8.8	4.6
Sulfate	56	7.5	11	1.3	12	3	15	3.8	116	74
Flow in cfs	1,170	21	490	20	367	32	5,400	116	410	11.5
Number of Analyses	37		50		38		50		10	

VI. ECONOMY

An assessment of future municipal and industrial, and quality control requirements in the Elkhorn River Basin involves an appraisal of the area's industrial and population growth potential. The future demand for goods and services from the projected growth of the nation could create an opportunity to the basin for attracting new industries or expand existing ones.

The economic and population projections were the basis for determining future water requirements for municipal and industrial and quality control purposes.

The study area for the Elkhorn River Basin was defined as the counties of Antelope, Cuming, Dodge, Holt, Madison, Pierce, Stanton, and Wayne in Nebraska.

PresentGeneral

Agriculture and its related activities have had the most significant effect on the basin's economy in terms of employment and monetary returns. In 1960, 16,806 persons or 36 percent of the labor force was employed on the farm. Ten percent of the labor force was employed in manufacturing, while less than one percent was employed in the mining category. The dependent industries listed under the services (including construction, transportation, communications, utilities, retail and wholesale trade, public administration, and personal services) employed the largest portion with 23,851 or 51 percent of the total labor

force. The remaining three percent of the labor force was unemployed. Refer to Table VI-1 for employment data.^{1/}

Table VI-1^{1/}

The Number and Percent
of the
Labor Force by Major Classifications

Elkhorn River Basin
1950 - 1960

	<u>1950</u>		<u>1960</u>	
	<u>Number</u>	<u>Percent</u>	<u>Number</u>	<u>Percent</u>
Farm	21,035	43	16,806	36
Mining	106	-	109	-
Manufacturing	2,483	5	4,483	10
TOTAL BASIC	23,624	48	21,398	46
TOTAL SERVICE	24,253	50	23,851	51
Unemployed	888	2	1,149	3
Total Labor Force	48,765	100	46,398	100

Agriculture

Agriculture has been the principal basic economic activity in the study area. Agricultural employment in the study area declined from 21,035 in 1950 to 16,806 in 1960. Despite the decrease in the farm employment, agricultural production has increased, when measured by dollar returns. The value of agricultural production increased from 142.4 million dollars in 1954 to 201.2 million dollars in 1959 (adjusted to the 1961 value of the dollar). Farm consolidation, intensified crop production and increased farm technology were primarily responsible for the increasing farm income and decreasing farm employment.^{2/}

According to the 1959 census of agriculture, there were approximately 180 thousand acres of land irrigated in the study area.^{2/}

Mining

Mineral production in the study area is limited to sand and gravel, and stone. These minerals are used mainly for local construction purposes.^{4/}

Employment in this category is a minor portion of the total employment ranging from 106 in 1950 to 109 in 1960.^{1/}

Manufacturing

Manufacturing employment in the Elkhorn River Basin comprised only ten percent of the total labor force in 1960. However, since 1950, this employment increased from 2,483 to 4,483 in 1960.

In 1960, food and kindred products and fabricated metals (including vehicles, machinery, transportation equipment, and other durables) employed over 80 percent of the manufacturing employment. All other categories were relatively insignificant.^{1/}

Population

The total population of the study area has remained somewhat static over the past fifty years, increasing slightly from 112,637 in 1910 to 118,413 in 1960. However, there have been shifts in population from the rural to the urban sectors. The urban sector increased from 14,743 in 1910 to 43,657 in 1960, while the rural sector decreased from

97,894 in 1910 to 74,756 in 1960. The study area's rate of change has been similar with the State of Nebraska as a whole. Refer to Table VI-2 for Nebraska and the study area population changes.^{5/}

Future

The economy of the study area has been undergoing a change from a primary agricultural economy to a more balanced industrial-agricultural nature. This pattern of economic activity is expected to continue. Table VI-3 depicts projected employment data by major categories for the study area.

Agriculture is expected to continue to make up a larger portion of the future income of the study area. However, a continued increase in farm technology will achieve this high rate of production with a decreasing farm employment.

Manufacturing in the study area is expected to increase in employment and income. Employment in this category is projected to increase to 9,800 in 2015. The most significant increases are projected in the fabricated metal, and food and kindred products categories.

The mining category is expected to remain relatively stable with employment increasing slightly to about 200 in 2015. These returns are expected to have moderate increases primarily in the extraction of sand and gravel, and stone used for local construction purposes.

Table VI-2

Population DataElkhorn River Basin
1910 - 1960

	1910	1920	Percent Change 1910-1920	1930	Percent Change 1920-1930	1940	Percent Change 1930-1940	1950	Percent Change 1940-1950	1960	Percent Change 1950-1960
NEBRASKA	1,192,214	1,296,372	+8.7	1,377,963	+6.3	1,315,834	-4.5	1,325,510	+0.7	1,411,330	+6.5
Urban	310,852	405,293	+30.4	486,107	+19.9	514,148	+5.8	606,530	+18.0	733,595	+20.9
Rural	881,362	891,079	+1.1	891,856	+0.1	801,686	-10.1	718,980	-10.3	677,735	-5.7
STUDY AREA	112,637	120,033	+6.6	126,807	+5.6	118,449	-6.6	116,001	-2.1	118,413	+2.1
Urban	14,743	18,226	+23.6	22,124	+21.4	30,113	+36.1	35,377	+17.5	43,657	+23.4
Rural	97,894	101,807	+4.0	104,683	+2.8	88,336	-15.6	80,624	-8.7	74,756	-7.3

VI-5

Table VI-3

Projected Employment of the
Labor Force by Major Classification

Elkhorn River Basin
2015
(Thousands)

	<u>2015</u>
Farm	14.0
Mining	.2
Manufacturing	9.8
TOTAL BASIC	24.0
TOTAL SERVICE	43.2
Unemployed	2.8
TOTAL LABOR FORCE	70.0

Communications, transportation, utilities, retail and wholesale trade, and other personal services will continue to employ the largest portion of the labor force. An increasing proportion of the labor force will be employed in the dependent industries (services).

The change from a predominately agricultural type economy to a more diversified agriculture-manufacturing type is expected to reverse the downward population trend. Historical data indicated that the study area population change coincided closely with the State. Therefore, the study area was projected at approximately the same rate as the State, reaching 200,000 in 2015. The urban portion is projected to reach 135,000 in 2015, while the rural portion should reach 65,000 in 2015, as shown in Table VI-4.^{7/}

Table VI-4

Population ProjectionsElkhorn River Basin2015

(Thousands)

	<u>2015</u>
Urban	135.0
Rural	<u>65.0</u>
Total	200.0

VII. WATER QUALITY CONTROL

Municipal, Industrial and Agricultural Pollution

Data on municipal and industrial waste discharges presented in the Public Health Service Municipal Waste Inventory are provided by the Nebraska State Department of Health. These data are shown in Exhibit 3 of the Appendix.

The points of municipal waste discharge are shown on Figure VII-1. Significant amounts of waste are discharged at the following points: Fremont, West Point, Norfolk, and O'Neill. Only primary treatment of wastes is provided at Fremont, West Point, and Norfolk and no treatment is provided at O'Neill.

Sufficient data are not available to quantify possible agricultural pollution in the form of runoff from feed lots and pollution by pesticides.

Water Quality Objectives

Water quality control needs are based on the uses to which a stream may be put. Contaminated water can endanger the health of persons living near or coming in contact with the streams and unattractive water can reduce the aesthetic enjoyment of living in the vicinity of streams, rivers and lakes. Failure to meet the objectives at too frequent intervals can prevent the best use of a stream.

The objectives used in evaluating water quality conditions in the Elkhorn River Basin are based on consideration of the objectives of Nebraska, of various interstate agencies, and those that have been

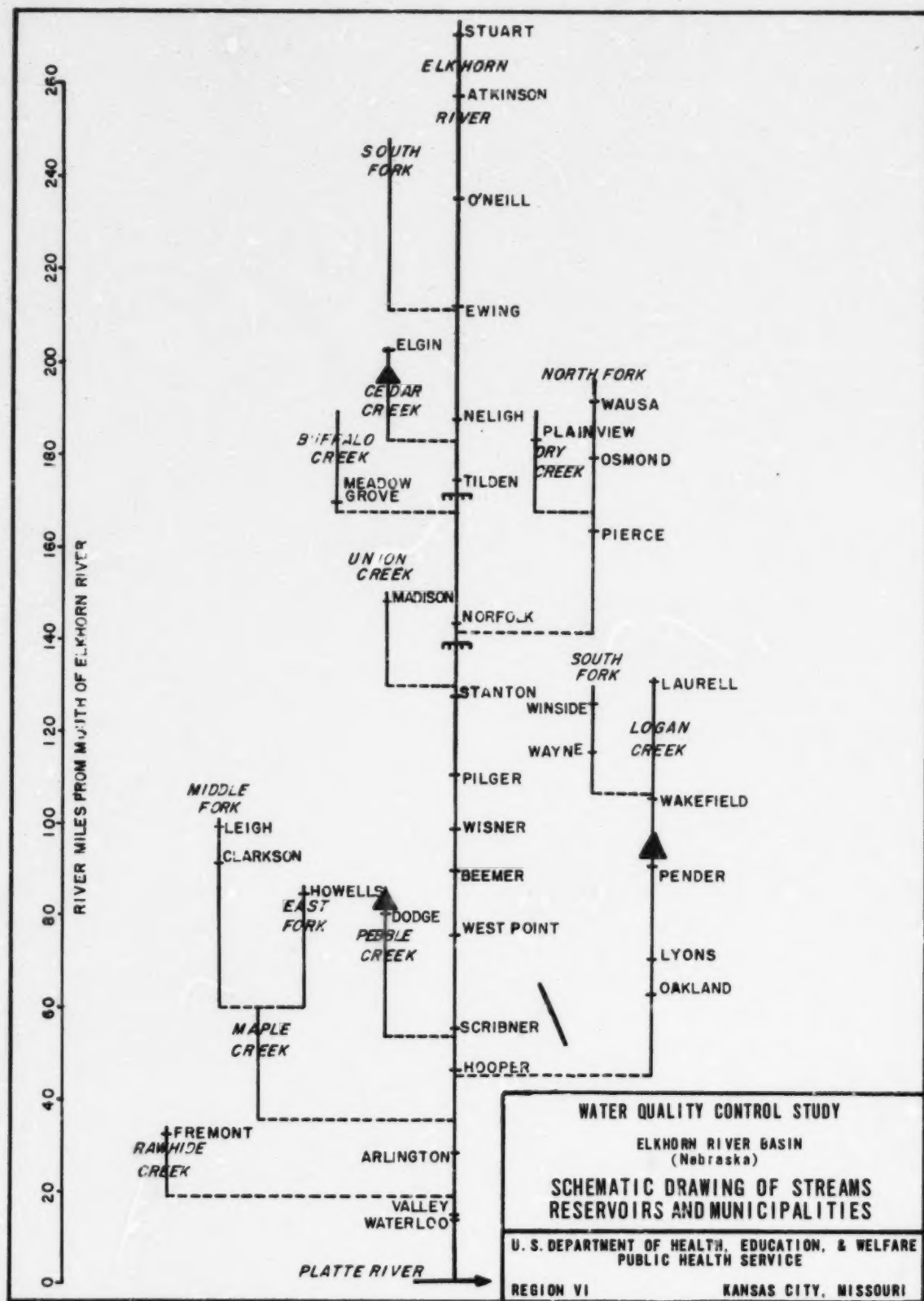


FIGURE VII-1

used in the past by the Public Health Service in similar situations.

The inorganic or mineral quality of the water in the basin is satisfactory and it is expected to remain satisfactory throughout the study period; therefore, the quality control needs in this study are based on the effect of organic material in the stream. The effect of organic waste discharge and the hydraulic characteristics of individual streams is reflected in the D. O. (dissolved oxygen) level. Maintenance of some dissolved oxygen is essential to prevent nuisance conditions. Concentrations of at least 3-5 mg/l are necessary to maintain fish and other aquatic life associated with desirable recreation use of a stream.

A dissolved oxygen objective of at least 5 mg/l has been selected in this study for the surface waters in the Elkhorn River Basin to maintain the health aspects, fish and aquatic life and to maintain and enhance present and anticipated recreational use of the stream.

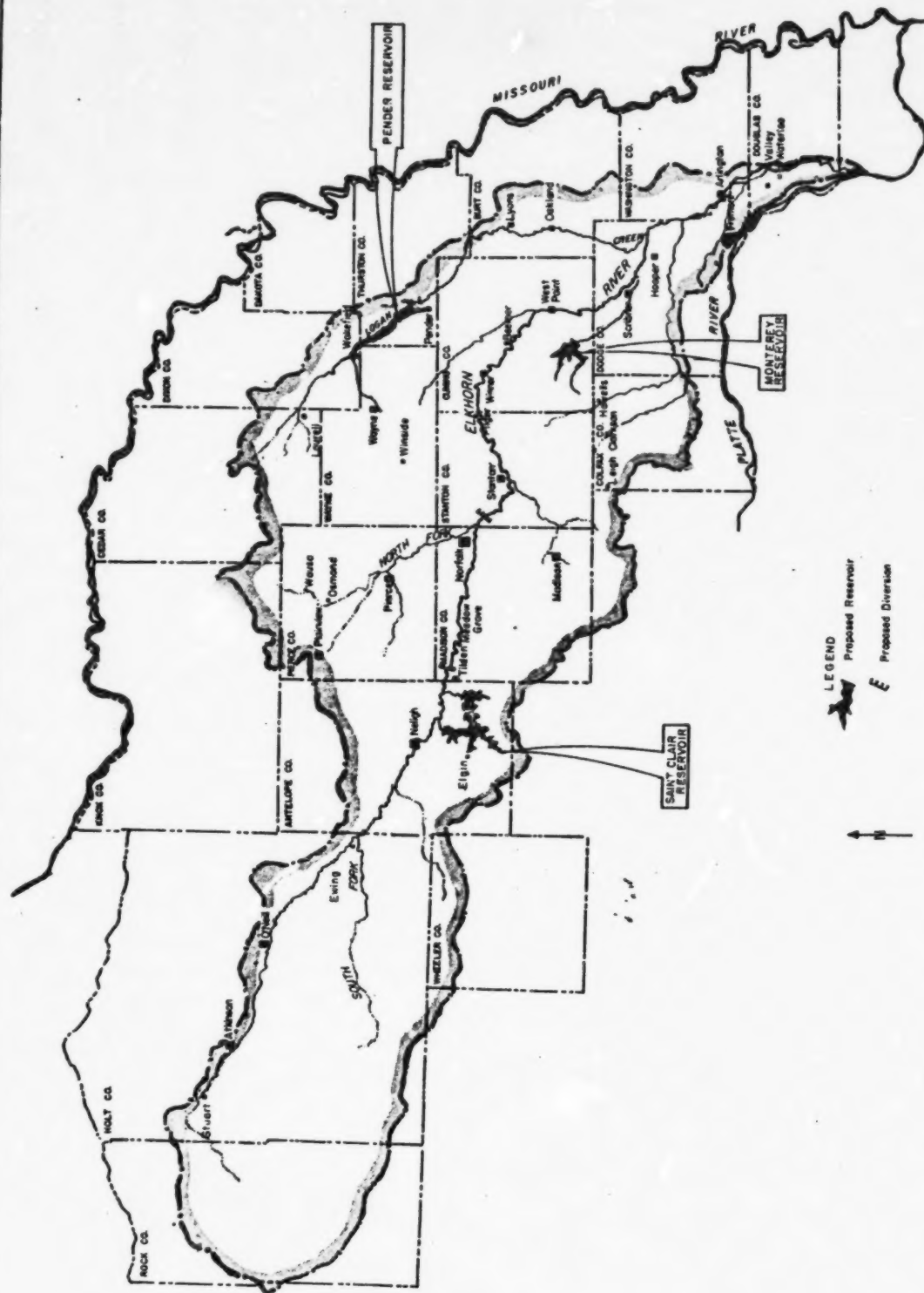
Flow Regulation

The Federal Water Pollution Control Act, as amended (33 U.S.C. 466 et seq) provides that consideration must be given in the planning of a reservoir by a Federal agency to the inclusion of storage for regulation of streamflow for the purpose of controlling water quality. The law also states that such storage and water releases shall not be provided as a substitute for adequate

treatment or other methods of controlling wastes at their source.

In order to estimate the amount of dilution water necessary to maintain a minimum of 5 mg/l D. O. in the stream, assumptions were made that (1) an 85 percent removal of BOD at present, reaching 90 percent by 2015 can be attained with well operated secondary waste treatment plants (2) the municipal and industrial return flow is 70 percent of the water intake in the summer months, 78 percent in the spring and fall and 90 percent in the winter months (3) this return flow will contain 0.25 pounds ultimate first stage BOD per capita and (4) water temperatures in the summer months (June through September) will average 24° C, 10° C in the fall (October and November), 2° C in the winter (December through March) and 16° C in the spring (April and May).

Considering the above named conditions, streamflow requirements at Fremont and Norfolk are shown in the following table.



LEGEND
 Proposed Reservoir
 Proposed Diversion

WATER QUALITY CONTROL STUDY

ELKHORN RIVER BASIN
 (460-8000)

LOCATION MAP

U. S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
 PUBLIC HEALTH SERVICE
 REGION VI
 KANSAS CITY, MISSOURI

FIGURE VII-2

Table VII-1

Streamflow Requirements for Adequate Dilution of Wastes
(Requirement in MGD)

	<u>Fremont</u>		<u>Norfolk</u>	
	<u>1965^{1/}</u>	<u>2015^{2/}</u>	<u>1965^{1/}</u>	<u>2015^{2/}</u>
Spring	46	81	11	20
Summer	128	183	14	51
Fall	21	41	6	15
Winter	9	28	3	11

^{1/} Secondary treatment, 85 percent removal of BOD

^{2/} Secondary treatment, 90 percent removal of BOD

The above points represent the heaviest waste loadings in the basin. It is believed that if these needs are satisfied all other points in the basin will have adequate dilution.

The streamflow in the basin is adequate to meet the demands 90 percent of the years without regulation; therefore, it is considered that there is no need for storage for streamflow regulation for water quality control, if these minimum flows are maintained after project construction.

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Exhibit No. 1

Municipal Water Supplies in the Elkhorn River Basin
of Municipalities with a 1960 Population in Excess of 500 Persons

Municipality	1960 Population	1963 Population Served	Water Treatment	Source of Supply	Estimated Maximum		speed
					Dependable Draft (MGD)	Average Output (MGD)	
Arlington	740	790	Aeration, coagulation, filtration	3 Wells	1.296	.095	120
Atkinson	1,324	1,310	None	3 Wells	1.200	.196	150
Bassett	1,023	1,020	None	3 Wells	1.000	.153	150
Battle Creek	587	575	None	3 Wells	1.600	.086	150
Beemer	667	670	None	2 Wells	.350	.030	45
Clarkson	797	795	None	2 Wells	.144	.160	201
Dodge	649	650	None	2 Wells	.500	.100	154
Elgin	881	880	None	2 Wells	.259	.130	148
Ewing	583	575	None	2 Wells	.395	.060	104
Fremont	19,698	19,700	None	20 Wells		3.323	169
Hooper	832	825	None	2 Wells	.860	.140	170
Howells	694	670	None	3 Wells	.540	.100	150
Humphrey	801	805	None	3 Wells	.645	.100	124

Exhibit No. 1 (cont'd)

Municipality	1960 Population	1963 Population Served	Water Treatment	Source of Supply	Estimated Maximum Dependable Draft (MGD)	Average Output (MGD)	
						per day	per year
Laurel	922	920	None	2 Wells	.360	.100	109
Leigh	502	485	None	2 Wells	.720	.046	95
Lyons	974	970	Aeration, softening, filtration	2 Wells	.288	.168	173
Madison	1,513	1,500	None	3 Wells	1.140	.300	200
Neligh	1,776	1,775	None	8 Wells	1.600	.250	141
Norfolk	13,640	13,700	Aeration, filtration	5 Wells	4.240	1.867	136
Oakland	1,429	1,420	Aeration, chlorination, filtration	3 Wells	1.230	.250	176
O'Neill	3,181	3,230	None	5 Wells	1.080	.290	90
Osmond	719	715	None	3 Wells	.561	.107	150
Pender	1,165	1,165	None	3 Wells	.430	.100	86
Pierce	1,216	1,225	None	2 Wells	.505	.184	150
Plainview	1,467	1,700	None	3 Wells	.830	.255	150
Randolph	1,063	1,070	None	2 Wells	.432	.218	204

Exhibit No. 1 (cont'd)

Municipality	1960 Population	1963 Population Served	Water Treatment	Source of Supply	Estimated Maximum Dependable Draft (MGD)	Average Output (MGD)	speed
Scribner	1,021	1,055	Aeration, chlorination, filtration	2 Wells	1.080	.156	150
Stanton	1,317	1,290	None	6 Wells	1.200	.110	85
Stuart	794	795	None	2 Wells	.433	.140	176
Tilden	917	880	None	3 Wells	.650	.140	159
Valley	1,452	1,550	None	3 Wells	1.080	.250	161
Wakefield	1,068	1,090	Aeration, filtration	2 Wells	.187	.200	183
Waterloo	516	560	None	Well	.360	.084	150
Wause	724	730	None	2 Wells	.220	.050	68
Wayne	4,217	4,500	None	5 Wells	2.000	.500	111
West Point	2,921	3,100	Aeration, coagulation, chlorination, filtration	6 Wells	1.340	.425	137
Winer	1,192	1,150	None	2 Wells	.288	.224	195

Exhibit No. 2

Basic Data on Sources of Pollution

Elkhorn River Basin

Municipality	Miles Above Mouth		Estimated P.E. (BOD)		Nature of Waste	Treatment Provided	P.E. (BOD) Discharged
	Elkhorn Trib.	Sub-Trib.	1960 Pop.	Before Treatment			
<u>Elkhorn River</u>							
Waterloo	13		516	500	Domestic	Primary	350E
Valley	15.1		1,432	1,400	Domestic	Primary	910E
Prescott	22.4		19,698	13,600	Domestic	Primary	84,000
					& Industrial		
Arlington	27.7		740	700	Domestic	Secondary	270E
<u>Maple Creek</u>	34.8						
<u>E. Fork Maple Creek</u>							
Howells	25.5	21.2	694	600	Domestic	Secondary	60E
<u>Middle Fork Maple Ck.</u>							
Clarkson	25.5	29.7	797	780	Domestic	Secondary	80E
Leigh		38.5	502	500	Domestic	Secondary	50E
<u>Logan Creek</u>	43.8						
Oakland*	17	1,429	1,330	1,330	Domestic	None	1,330E
Lyons*	24.8	974	960	2,900	Domestic	None	-
					& Industrial		
Pender	44.6	1,165	1,350	3,030	Domestic	Secondary	300E
					& Industrial		
Wakefield	60	1,068	1,150	1,150	Domestic	Secondary	115E
<u>South Fork Logan Ck.</u>							
Wayne	60	9.6	4,217	4,000	Domestic	Secondary	615E
Winside*		19.4	416	400	Domestic	None	400E
Laurel*	85	922	780	780	Domestic	Primary	780E
		832	700	700	Domestic	Primary	455E
Hooper	45.2						
<u>Pabble Creek</u>	53.1						
Dodge			649	640	Domestic	None	640
Scribner*	55	1,021	1,000	1,000	Domestic	None	1,000E

Exhibit No. 2 (cont'd)

Municipality	Miles Above Mouth	Sub-Trib.	1960 Pop.	Estimated Pop. Served	P.E. (3000) Before Treatment	Nature of Wastes	Treatment Provided	P.E. (3000) Discharged
<u>Elkhorn River</u>								
West Point	75.5		2,921	2,500	4,100	Domestic & Industrial	Primary	2,660E
Beemer	89		667	600	600	Domestic	None	600
Wiener	98.3		1,192	1,180	1,180	Domestic	Secondary	120E
Pilger	110.5		491	470	470	Domestic	None	470
Stanton**	127.2		1,317	900	900	Domestic	Primary	900E
<u>Union Creek</u>								
Meridan Creek	128.7	15.8						
<u>Tracy Creek</u>								
Humphrey		4.5						
Madison		13.8	801	780	800	Domestic	Secondary	80E
N. Branch Elkhorn R.	141.8	18.3	1,513	1,490	1,490	Domestic	Lagoon	0
Pierce		22.4	1,216	1,100	1,100	Domestic	Primary	715E
<u>Dry Creek</u>		25.5						
Plainview		14.5	1,467	1,440	1,440	Domestic	Lagoon	144
Osmond	38		719	700	700	Domestic	Secondary	600E
Weusa	50		724	750	750	Domestic	Secondary	250
Norfolk	143.5		13,640	13,500	25,000E	Domestic & Industrial	Primary	15,000E
<u>Battle Creek</u>								
Battle Creek	156.7	1.7	587	580	580	Domestic	Primary	290
<u>Buffalo Creek</u>								
Buffalo Creek	167.7		430	370	370	Domestic	Primary	280E
Meadow Grove		1	917	850	850	Domestic	Primary	850
Tilden	174.2							
<u>Cedar Creek</u>								
Elgin	181.9	20.7	881	850	850	Domestic	Secondary	210E
Neligh	187.7		1,776	1,750	-	-	None	-
Ewing	211.5		583	580	580	Domestic	Primary	360E
O'Neill	236.1		3,181	2,500	4,820	Domestic & Industrial	None	4,820E
Atkinson	258		1,324	1,200	1,200E	Domestic	None	1,200
Stuart	269.5		794	450	450	Domestic	Secondary	225E

* Application being processed

** Under construction

Exhibit No. 3

Historical Streamflows in the Elkhorn River Basin

Station	Drainage Area (sq. mi.)	Years of Record	Flow in cfs		
			Maximum	Minimum	Average
Elkhorn River at Ewing	1,400	17	7,500	9.0	212
South Fork Elkhorn River at Ewing	320	10	1,760	11	81
Elkhorn River at Heligh	2,200	32	12,300	12	295
Elkhorn River near Norfolk	2,790	19	13,500	60	559
Logan Creek near Vehling	1,030	23	19,400	14	175
Elkhorn River at Waterloo	6,900	44	100,000	50	1,120